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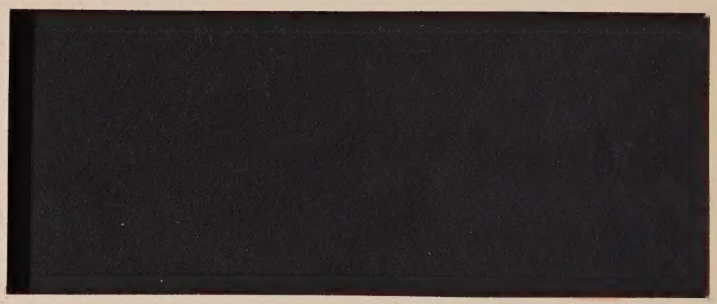

BLH
SWITCHING AND
BALANCING UNIT
TYPE 525

208915-1

INSTRUCTION MANUAL

FOR BLH
TYPE 525
SWITCHING AND BALANCING
UNIT

Designed and Manufactured by
BALDWIN-LIMA-HAMILTON CORPORATION
ELECTRONICS AND INSTRUMENTATION DIVISION
WALTHAM, MASSACHUSETTS

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SECTION 1
GENERAL INFORMATION

1.0 GENERAL.

The type 525 Switching and Balancing Unit, Figure 1, provides a means by which a group of up to ten 2 or 4 arm bridge outputs can be monitored in succession on one strain indicator. When monitoring of more than 10 strain gage outputs is necessary, two or more switching and balancing units can be stacked and their output terminals connected in parallel to the indicating instrument. This provides an additional number of channels. Each channel can be balanced on zero, or a desired reference point, over a nominal range of ±7000 microinches per inch.

Measurements can be made with both 2 and 4 arm gage bridges in the same test. It is recommended that all operators read Section 3, Installation, and Section 4, Operation, prior to wiring and operating this unit.

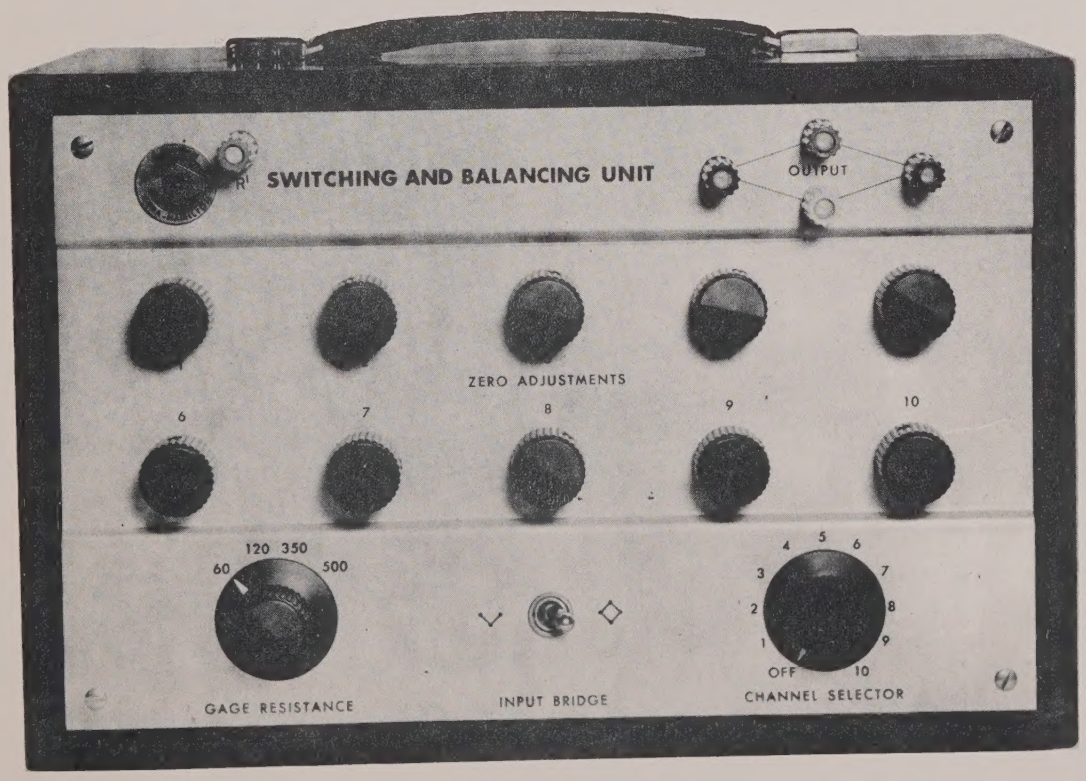


Figure 1. Type 525 Switching and Balancing Unit

SECTION 2
DESCRIPTION

2.0 DESCRIPTION

2.1 The Type 525 Switching and Balancing unit is contained in a Formica case having a convenient carrying handle. The front panel contains the balancing potentiometers, gage resistance switch, input bridge selector switch, channel selector switch, and a set of 5 output terminals. The rear panel contains 10 groups of 5 terminals each for connecting the various gage configurations. Engraved instructions for three of the most common methods of gage onnections are on the lower section of this panel.

2.2 The BALANCING POTENTIOMETER shafts are friction loaded so they will maintain their set position. By adjusting the respective Balancing Potentiometer, each set of gages selected thru the channel selector switch can be either balanced or set to a reference level over a nominal range of $\pm$7000 microinches per inch. Each potentiometer is connected across the gage excitation thru its respective channel selector switch position. The slider arm output passes thru its respective channel selector switch position to the Gage Resistance switch.

2.3 The GAGE RESISTANCE switch maintains the full balancing range when using strain gages of 60, 120, 350, or 500 ohms for full bridge (four arm) operation. The gage resistance switch should be set to the value of the internal resistors of the strain indicator in use for two arm bridge operation to achieve full balancing range, regardless of the value of the external measured gage resistance.

2.4 The INPUT BRIDGE selector switch selects either two arm bridge input or four arm bridge input. When positioned on two arm input the output of the balancing potentiometer is connected to the center of the internal half bridge of the strain indicator through the R' terminal. When positioned on four arm input the R' terminal is disconnected from the circuit.

2.5 The CHANNEL SELECTOR switch contains an OFF position and positions for each of the ten channels. Each channel is wired through this selector switch in such a manner that capacitive currents from channels not in use have no path and will not affect the immediate channel in use.

SECTION 3
INSTALLATION

3.0 INSTALLATION

3.1 WIRING. It is advisable to select lead materials which have low, stable resistivity, minimum temperature coefficient of resistance, coated with insulating materials which are equivalent to the electrical insulating quality of the gage carrier and bounding cements employed. The following materials have been found suitable for BLH strain gage use. For other than BLH strain gages consult the manufacturer.

Conductors	Operating Temperatures °F	
	Stable	Maximum
Nickel-clad copper	700	1000
Stainless steel-clad copper	800	1300
Nickel-clad silver	1000	1500
Nichrome	700	1700

Insulation	Temperature Range
Nylon	Below −100°F
Vinyl	−100 to 150°F
Polyethylene	−100 to 200°F
Teflon	−100 to 500°F
Glass impregnated silicone	above 500°F
Glass sleeving	above 500°F

It is preferable to solder connections to the gage lead wires. Clean, tinned spade type lugs soldered to the lead wires are preferable for connections to the binding posts of the instrument. Stranded wire, if used, should have all strands intact and special care should be taken to see that all strands are soldered.

3.2 When the lead wire lengths are more than 50 feet, special circuits or shielding may be necessary. Where this equipment is being operated in the vicinity of strong electrical disturbances, it may be necessary to use shielded cable for the leads. The shield of this cable should be grounded at only one point.

3.3 PRECAUTIONS. To obtain maximum accuracy and performance, certain precautions should be taken, as follows:

a. Make certain that the lead wires from the active and compensating gages to the Switching and Balancing Unit are the same length.

b. All cable and shields should be connected before any channel is set to zero or a reference.

c. When using shielded leads the shields should be connected to the "W" terminal of their respective channels.

3.4 GAGE CONNECTIONS. In making the following connections to the Switching and Balancing unit refer to the respective engraved bridge configurations of Figure 2.

A. TWO ARM BRIDGE, WITH OWN COMPENSATING GAGE

When the gage configuration consists of a single or a group of active gages each with its own compensating gage, make the gage lead wire connections to the Switching and Balancing unit as follows:

1. Connect a two arm gage configuration to channel 1 input terminals as shown in Figure 2 (TWO ARM).

2. Connect a two arm gage configuration to channel 2, 3, etc. input terminals for as many half bridges as desired up thru channel 10.

B. TWO ARM BRIDGE, COMMON COMPENSATING GAGE

When the gage configuration consists of a group of active gages all served by a common compensating gage, make the gage connections to the Switching & Balancing unit as follows:

(1) Connect a two arm gage configuration to channel 1 input terminals as shown in Figure 2 (TWO ARM).

(2) Connect the remaining active gages to the "B" & "W" input terminals of channels 2, 3, 4 etc., as required, up thru channel 10.

(3) Tie all the "G" terminals of the channels used to the "G" terminal of channel 1.

C. TWO ARM BRIDGE, 3 WIRE

When the gage configuration consists of a single or a group of this type half bridge make the gage connections to the Switching and Balancing unit as follows:

(1) Connect the active gage lead wires (3 wires) to the "B", "W" & "W_1" input terminals of channel 1, see Figure 2 (TWO ARM, 3 WIRE).

(2) Connect the compensating gage between "W_1" and "G" input terminals of channel 1.

(3) Repeat (1) & (2) for channel 2, 3 etc. for as many channels as necessary up thru channel 10.

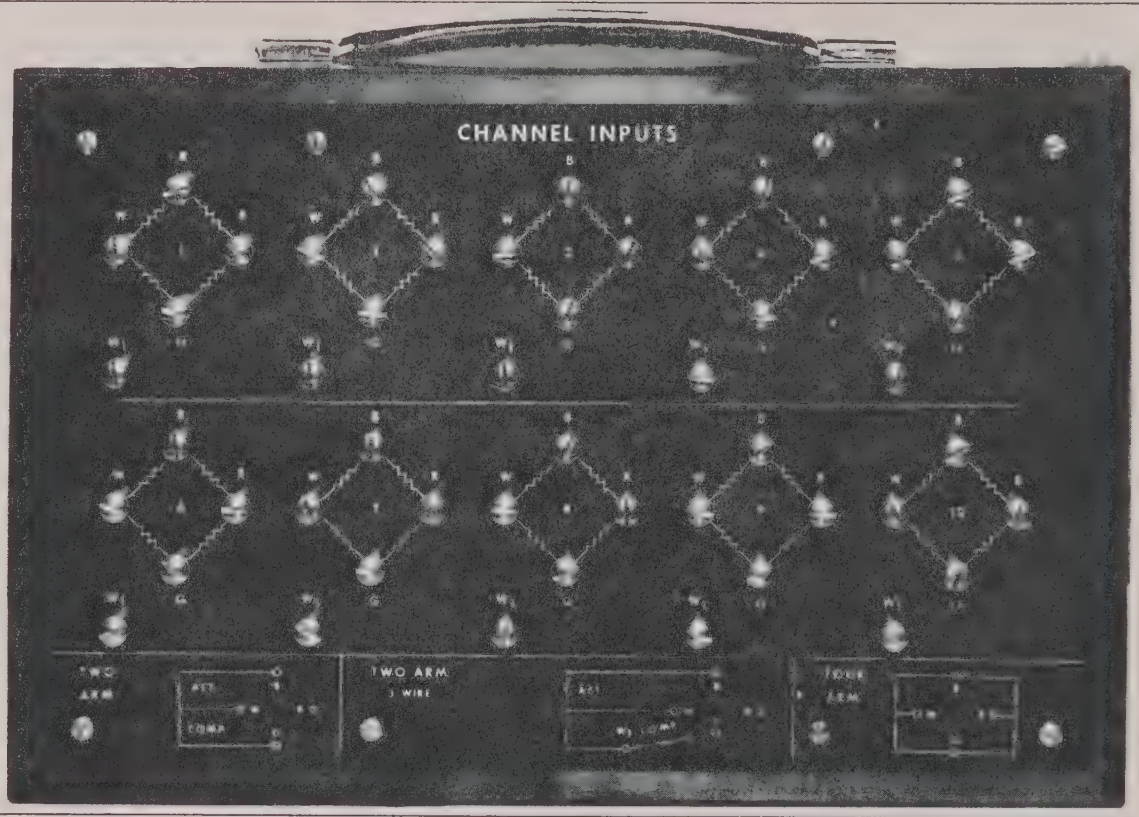


Figure 2. Rear Panel of Switching & Balancing Unit

D. TWO ARM BRIDGE, 3 WIRE, COMMON COMPENSATING GAGE

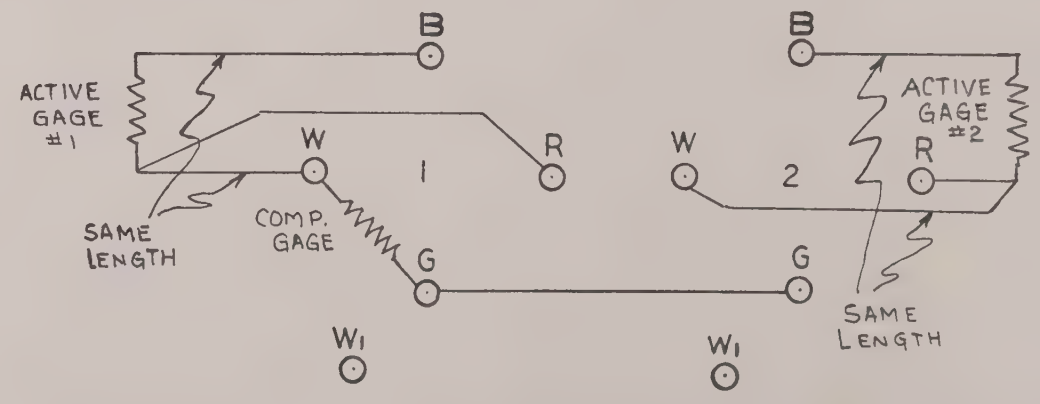
When the gage configuration consists of this type of half bridge make the gage connections to the Switching and Balancing unit as follows:

(1) Connect the compensating gage between terminals "G" and "W" of channel 1.

(2) Connect the active gage leads (3 wires) to terminals "B", "R" and "W" of channel 1.

(3) Connect all other active gages (3 wire) to terminals "B", "R" and "W" of channels 2, 3, 4 up thru channel 10. The leads for each active gage to the "B" and "W" terminals should be the same length.

(4) Common all "G" terminals in use for a group.



E. FOUR ARM BRIDGE

When the gage configuration consists of one or more full bridges make the connections to the Switching & Balancing Unit as follows:

(1) Connect each full bridge to a set of channel input terminals as shown in figure 2 (FOUR ARM): strain gage bridge #1 to channel 1, strain gage bridge #2 to channel 2, etc. thru strain gage bridge #10 to channel 10.

(2) Where increased measuring sensitivity is desired use two active and two compensating gages connected alternately around the bridge loop. The indicated strain will be twice the actual strain since the two active gages will produce an additive effect in unbalancing the bridge. This arrangement has been used effectively where the strains to be measured are very small.

3.5 CONNECTING TO STRAIN INDICATOR. In connecting the Switching & Balancing Unit to a Strain Indicator, three types of Indicators are considered: the Type 20, the Type "N", and the Type "M".

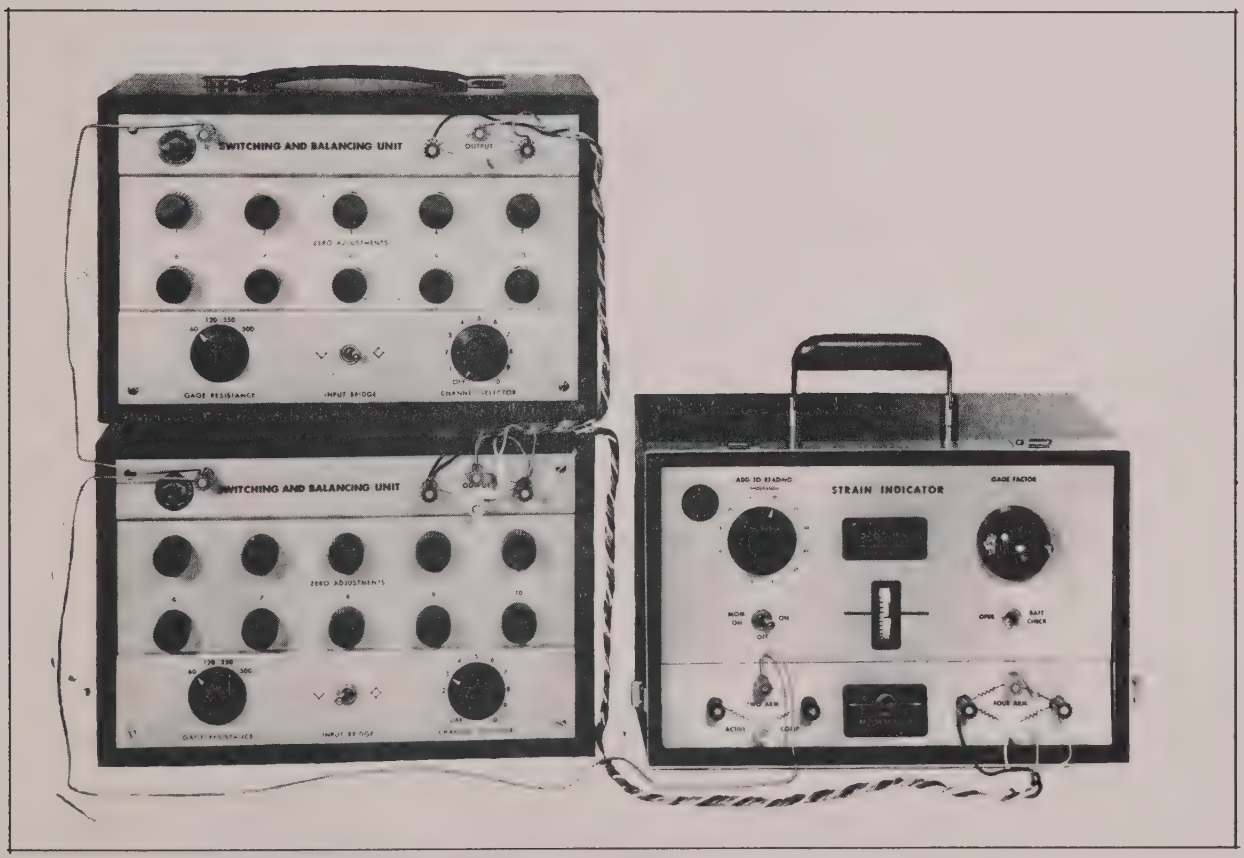
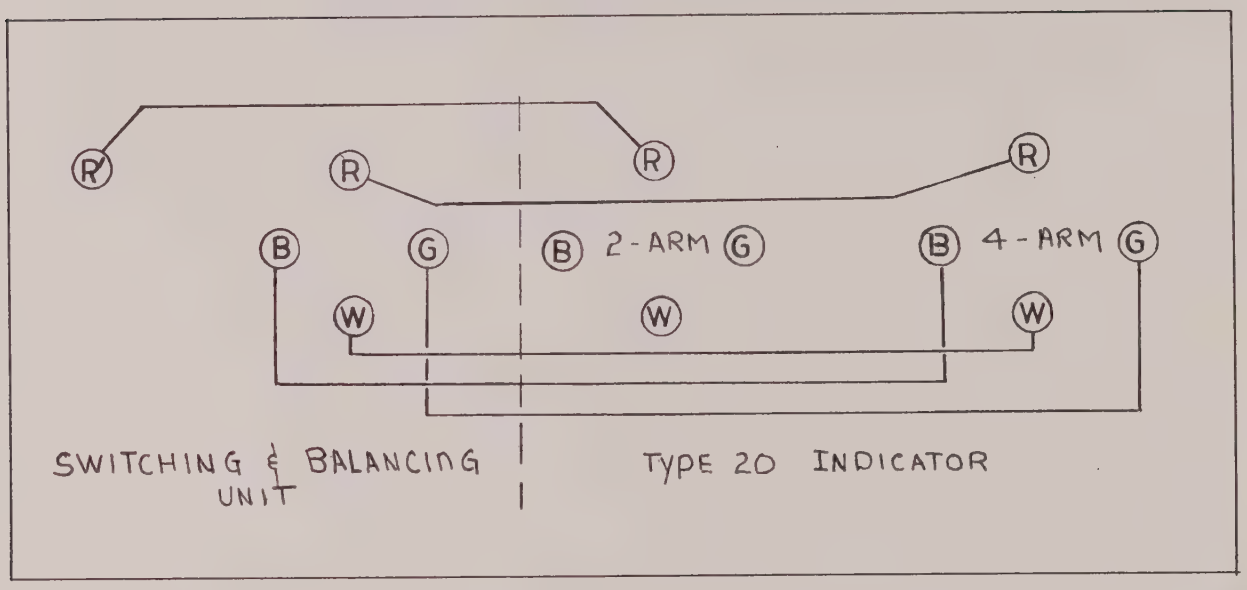


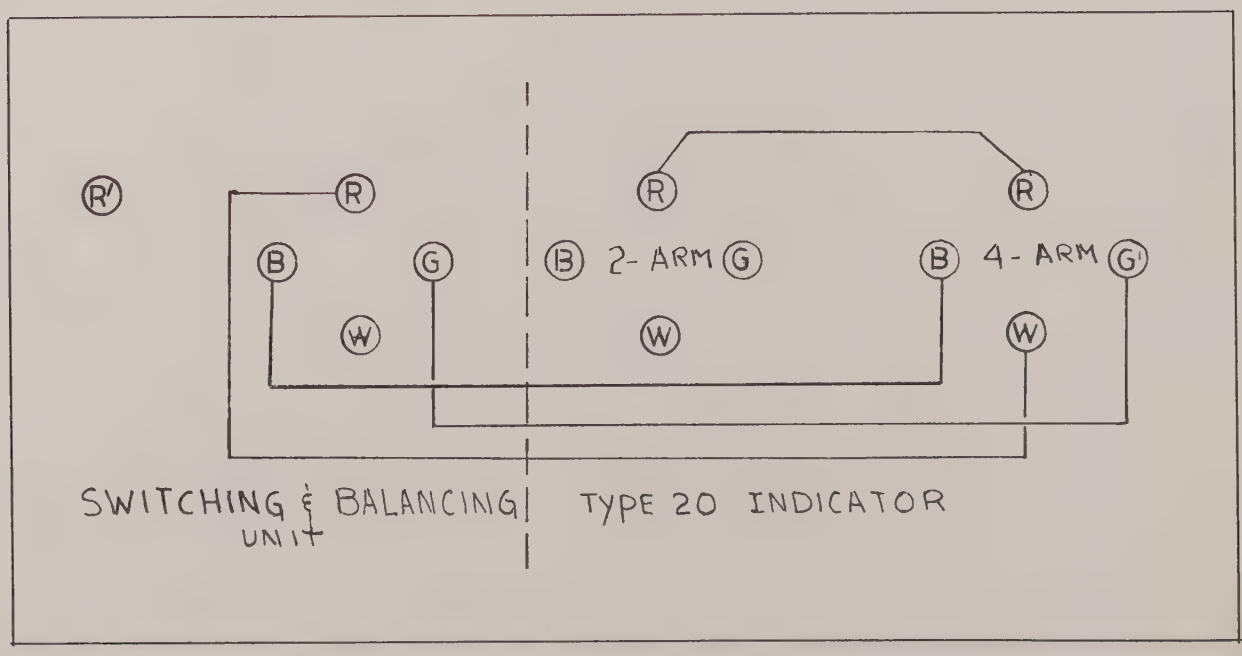
Figure 3. Stacked Switching and Balancing Units

A. CONNECTIONS TO TYPE 20 STRAIN INDICATOR

(1) Connect the Switching & Balancing Unit to the Strain Indicator in the following illustrated manner for monitoring all types half-bridge configuration except the 3-wire, common compensating configuration.

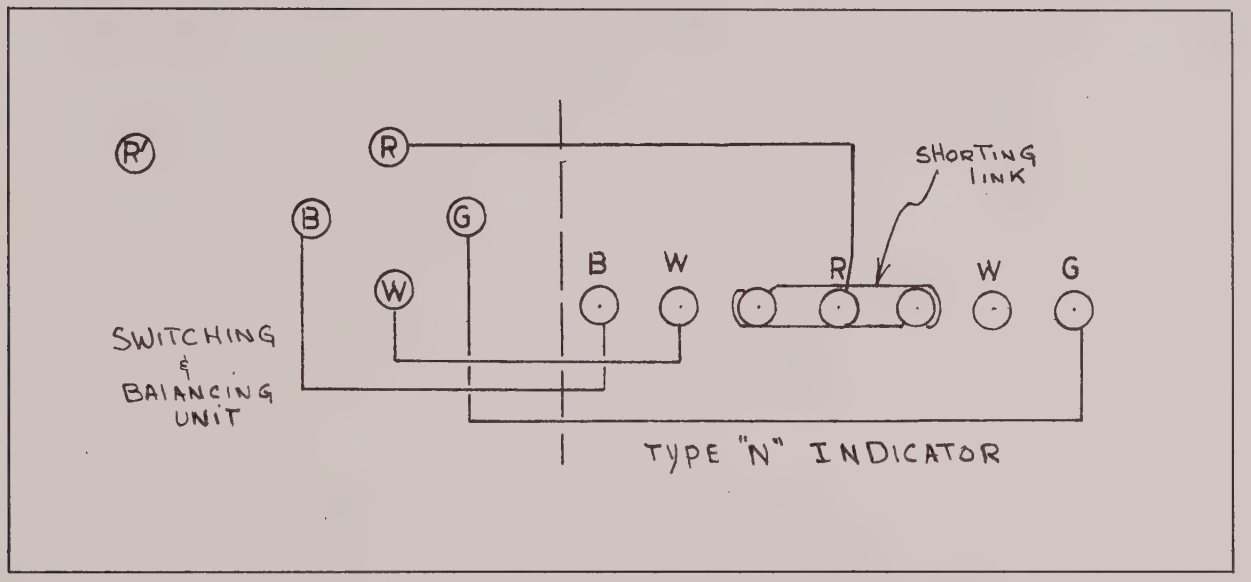


(2) For monitoring the 3-wire, common compensating configurations, connect the Switching & Balancing Unit to the Strain Indicator in the following illustrated manner.

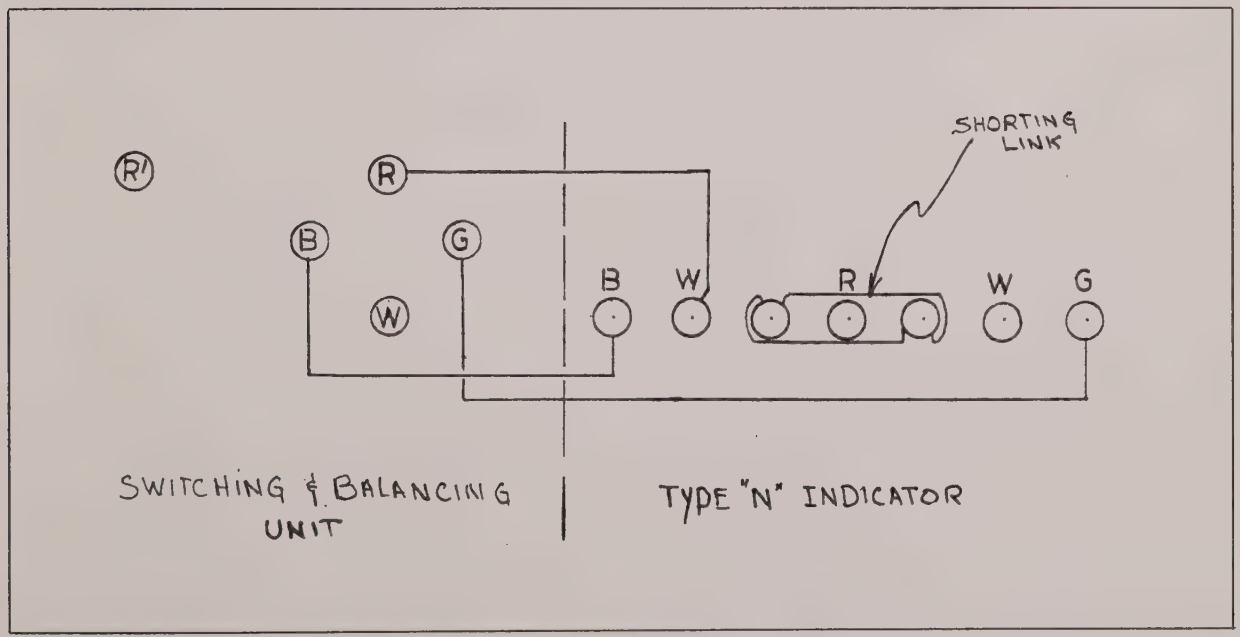


B. CONNECTIONS TO TYPE "N" STRAIN INDICATOR

(1) Connect the Switching & Balancing unit to the Strain Indicator in the following illustrated manner for monitoring all types half-bridge configurations except the 3-wire, common compensating gage configuration.

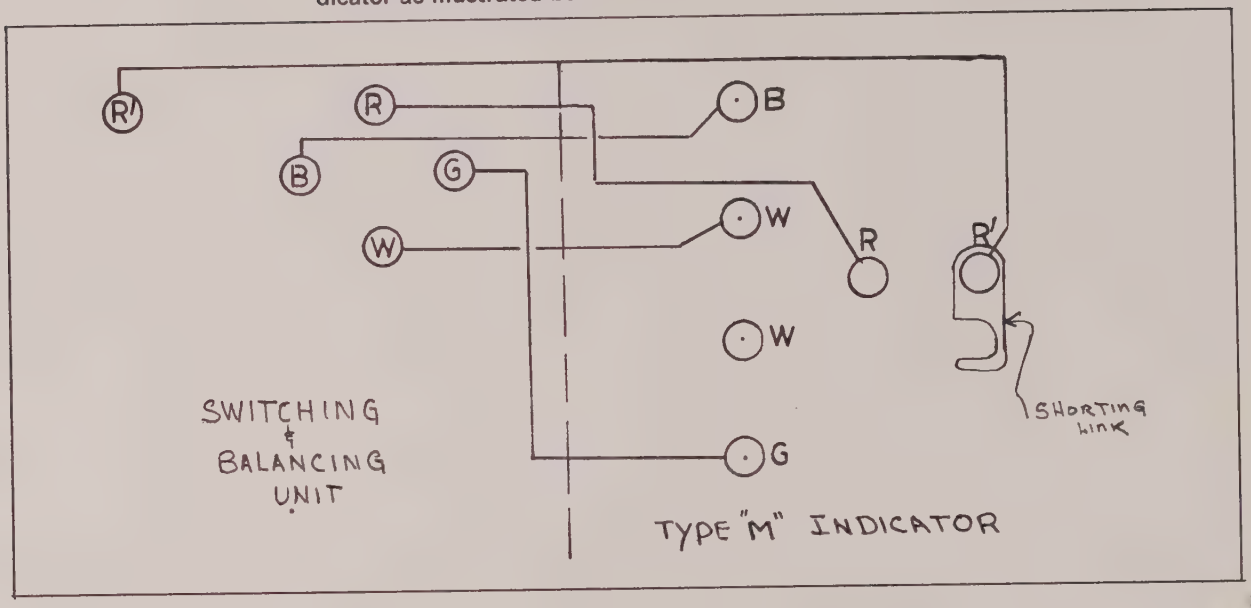


(2) When using the 3-wire, common compensating gage configuration make the connections from the Switching & Balancing Unit to the Type "N" Strain Indicator as follows:

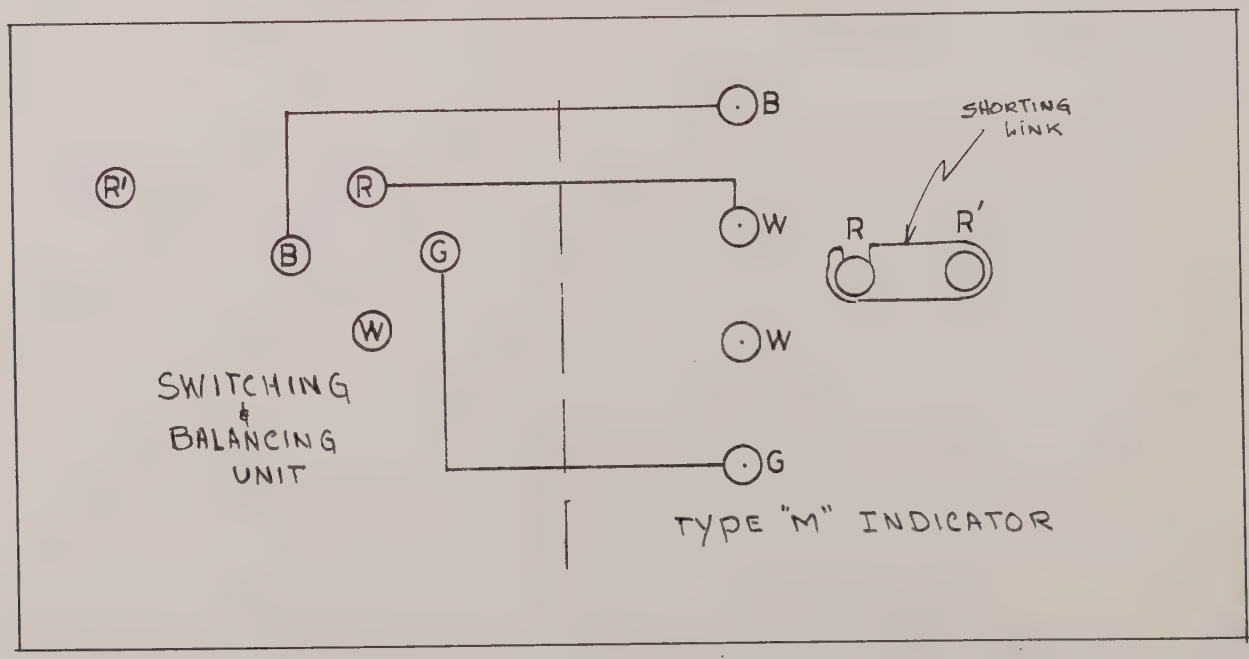


C. CONNECTIONS TO TYPE "M" STRAIN INDICATOR

(1) For monitoring all types of half-bridge configurations except the 3-wire, common compensating gage configuration make the connections from the Switching and Balancing Unit to the Type "M" Indicator as illustrated below:



(2) When using 3-wire, common compensating gage configuration make the connections from the Switching and Balancing Unit to the Type "M" Indicator as follows:



SECTION 4
OPERATION

4.0 OPERATION

4.1 TWO ARM. For operation when half bridge configurations are monitored proceed as follows:

A. STRAIN INDICATOR

1. TYPE 20 — Position INPUT BRIDGE switch on FOUR ARM position.

2. TYPE "N" — Connect JUMPER LINK.

3. TYPE "M" — Disconnect JUMPER LINK. (Connect JUMPER to "R" when using the 3-wire, common compensating gage configuration)

B. SWITCHING AND BALANCING UNIT

1. Position INPUT BRIDGE switch on HALF BRIDGE.

2. Position GAGE RESISTANCE switch for strain indicator in use, regardless of the value of the gages in use, as follows:

Type 20 — 500 ohms
Type "N" or "M' — 120 ohms

3. With CHANNEL SELECTOR switch on channel 1, set zero or desired reference point using ZERO ADJ. 1. Repeat for each channel in use using the respective ZERO ADJ. for that channel.

4. Proceed with strain measurement.

4.2 FOUR ARM. For operation when four arm bridge configurations are monitored proceed as follows:

A. STRAIN INDICATOR

1. TYPE 20 — Position Input BRIDGE switch on FOUR ARM position.

2. TYPE "N" — Disconnect JUMPER LINK.

3. TYPE "M" — Disconnect JUMPER LINK.

B. SWITCHING AND BALANCING UNIT.

1. Position Input BRIDGE switch on FULL BRIDGE.

2. Set GAGE RESISTANCE switch to the nearest value of the gages in use.

3. With CHANNEL SELECTOR switch on channel 1, set zero or the desired reference point using ZERO ADJ. 1. Repeat for each channel in use using the respective ZERO ADJ. for that channel.

4. Proceed with strain measurement.

4.3 CAPACITIVE BALANCE

(a) If the sensitivity (defined as meter divisions versus dial divisions) is not the same for each channel, or if the Strain Indicator is sluggish in one channel, a capacitive unbalance may exist. This capacitive unbalance is caused by the capacitance to ground and the capacitance between leads of each strain gage circuit. To compensate for this, proceed as follows:

1. Connect an oscilloscope to the Strain Indicator using the jack connection provided.

2. Zero the Indicator.

3. Place a decade capacitance box across the dummy gage.

4. Adjust the decade capacitance box until the signal on the oscilloscope is at minimum level. The Indicator should be continually adjusted to read zero while the decade capacitance box is being adjusted.

5. If more than one channel is to be compensated, the procedure is the same but the value necessary to eliminate the capacity problem should be noted. Each time that channel is to be used, the decade capacitance box should be adjusted to the correct value for the particular channel.

6. If placing a capacitance decade box across the dummy gage does not give a minimum null, the box should then be placed across the active gage. Proceed as noted in step (4).

4.4 SWITCH RESISTANCE. It should be pointed out that the switch resistance tends to increase under circumstances where the switch has not been moved for a long period of time. This is true of even the best switch materials, such as silver. It is always wise, after the Switching & Balancing Unit has stood with one or more switches in a given position for a considerable period, to give the switches several swings back and forth over the full range of their motion. This will dissipate by friction any foreign products which may have built up the switch resistance during the period of inactivity.

4.5 STACKING UNITS — When stacking two or more Switching and Balancing Units proceed with operation of the unit as in paragraph 4.2 or 4.3, however, all Switching and Balancing Units not in use must have the CHANNEL SELECTOR switch on

the OFF position and the INPUT BRIDGE switch on the FULL BRIDGE position.

4.6 RECORDING OR INDICATING INSTRUMENTS. The Type 525 Switching and Balancing Unit may be used with any mv/v recording or indicating instruments with the following considerations.

FULL BRIDGE. No special considerations, normal operation.

HALF BRIDGE. If the recording or indicating instrument contains an internal half bridge, connect the junction of this half bridge to the R' terminal. Connect the Black and Green terminals to the recorders half bridge excitation and the WHITE terminal to the recorders signal input ground. Set the GAGE RESISTANCE switch to the nearest value of the internal half bridge.

If a half bridge is not contained in the recording or indicating instrument connect two 120 ohm resistors; one across the R' and the BLACK terminal, the other across R' and the GREEN terminal of the Switching and Balancing unit. Connect R' to the high side of the signal input and the WHITE terminal to the low side or ground of the signal input of the recording instrument, and the BLACK and GREEN terminals to the gage excitation. Set the GAGE RESISTANCE switch on 120 ohms. In either case, the INPUT BRIDGE switch should be positioned on half-bridge. The 120 ohm resistors should be precision, wire wound, non-inductive, $\pm 1/20\%$ tolerance, and with a temperature coefficient of the wire equal to ± 20 PPM/°C (see Parts List).

SECTION 5
CALIBRATION

5.0 CALIBRATION

5.1 The 10 point Switching and Balancing Unit requires no calibration.

SECTION 6
MAINTENANCE

6.0 MAINTENANCE

6.1 No maintenance is required other than handling the unit as a precision instrument. Reasonable care should be taken in making connections to the rear panel so as not to damage screw terminals.

SECTION 7
TROUBLE SHOOTING

7.0 TROUBLE SHOOTING

7.1 The circuit has been designed for long trouble free operation. Should trouble occur it may be in the zero adjusting potentiometers or gage resistance switch, refer to Figure 4, wiring diagram, of one channel. All channels are identical.

7.2 To check the continuity of each potentiometer, connect an ohmmeter across the Black and Green output terminals. Rotate the channel selector switch to each channel. Each channel should read 2000 ohms $\pm 5\%$. With all zero adjusting potentiometers fully C. W. the continuity of the slide arm and the gage selector switch may be checked by placing the ohmmeter between the Black and the Red terminal. By rotating the gage resistance switch through the 60, 120, 350 and 500 ohm positions the following readings should be obtained; 4400 ohms, 8700 ohms, 25 K and 36 K.

7.3 Proper operation of the INPUT BRIDGE Switch can be checked by placing an ohmmeter across R and R' and operating the switch. The ohmmeter should read zero for half bridge operation and open for full bridge operation.

7.4 Check that voltage across the Black and Green output Terminals of the strain indicator is also across the "B" and "G" rear panel terminals of each channel when the channel selector switch is turned to the channel checked.

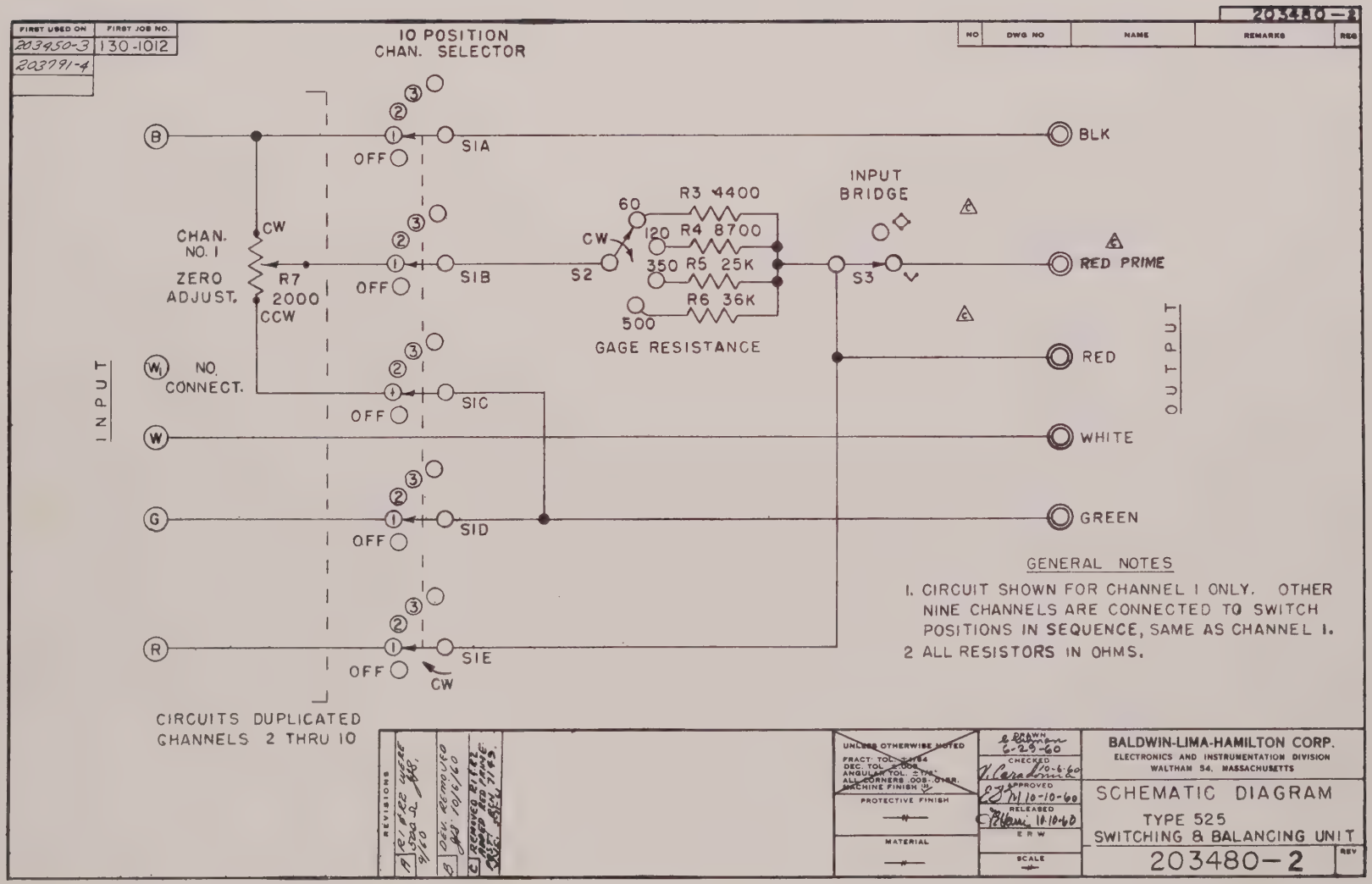


Figure 4. Schematic Diagram Switching & Balancing Unit

SECTION 8
SPECIFICATIONS

Input Configuration:	Full Bridges. Strain gage bridge or strain gage transducers.
	Half Bridges. Individual compensating gages, common compensating gages, group common compensating gages. 3 or 4 wire.
Gage Resistances:	60, 120, 350, 500 ohms on full bridge. 60-2000 ohms on half bridge.
Zero Adjustment:	$\pm$7000 μ in/in at a gage factor of 2.00.
Switching Repeatability:	Better than 1 μ in/in.
Industrial Design:	Compatible with Type 20 strain indicator.
	Units can be stacked and inter-connected to give 20, 30, 40 etc. Switching & Balancing points.
Size:	13" wide x 8½" high x 7½" deep.
Weight:	12 lbs.

SECTION 9
COMPONENT PARTS LIST

NOTE

When ordering parts from the factory always include the following information:

INSTRUMENT MODEL NO.

SERIAL NO.

B-L-H PART NO.

DESCRIPTION OF PART

Refer to schematic diagram type 525 Switching & Balancing unit, figure 4, for circuit reference.

CIRCUIT REF.	PART DESCRIPTION	B-L-H PART NO.	QUAN.
R3	Resistor, fixed, 4400 ohms ±½%, ¼W	Daven Co. #1250	1
R4	Resistor, fixed, 8700 ohms ±½%, ¼W	Daven Co. #1250	1
R5	Resistor, fixed, 25K ohms ±½%, ¼W	Daven Co. #1250	1
R6	Resistor, fixed, 36K ohms ±½%, ¼W	Daven Co. #1250	1
R7-R16	Potentiometer, 2000 ohms, Spectrol Model 860	128635-8	10
S1	Switch, Channel Selector, Leeds & Northrup	133384-8	1
S2	Switch, Gage Res.	132606-8	1
S3	Switch — Toggle,	133533-8	1
Terminal (B)	Binding post — black	133519-8	1
Terminal (G)	Binding post — green	133520-8	1
Terminal (R)	Binding post — red	133518-8	2
Terminal (W)	Binding post — white	133517-8	1
	MISCELLANEOUS		
	Ass'y Carrying Case	203423-9	1
	Front Panel	203449-3	1
	Ass'y, Rear Panel	203762-3	1
	Shaft Lock	203456-1	10
	Knob, Zero Adjust	124825-8	10
	Knob, Gage Res. & Channel Sel.	124851-8	2
	Matched Pair 120 ohm Resistors	207152-1	1

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